PCT/GB03/01556 #2

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Signed Andrew Gersey

Dated 30 April 2003

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Patents Form 1/77

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27 MAR 2002
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1/77

28MAR02 E707174-1 D02805
P01/7700 0.00-0207284.1

Request for grant of a patent

(See the notes on the back of this form. You can also get an explanatory leaflet from the Patent Office to help you fill in this form)

The Patent Office

Cardiff Road
Newport
South Wales
NP10 8QQ

1. Your reference

M02B124/RJB

2. Patent application number
(The Patent Office will fill in this part)

0207284.1 27 MAR 2002

3. Full name, address and postcode of the or of each applicant *(underline all surnames)*

The BOC Group plc, Chertsey Road, Windlesham, Surrey, GU20 6HJ

Patents ADP number *(if you know it)* ~~884627002~~ 7975949001

If the applicant is a corporate body, give the country/state of its incorporation: England

4. Title of the invention

Semiconductor Exhaust Gas Treatment

5. Name of your agent *(if you have one)*: Roger James Bousfield

"Address for service" in the United Kingdom to which all correspondence should be sent *(including the postcode)*

The BOC Group plc, Chertsey Road, Windlesham, Surrey, GU20 6HJ

Patents ADP number *(if you know it)* ~~973131002~~

6. If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or of each of these earlier applications and *(if you know it)* the or each application number

Country	Priority application number *(if you know it)*	Date of filing *(day / month / year)*

7. If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application

Number of earlier application	Date of filing *(day / month / year)*

8. Is a statement of inventorship and of right to grant of a patent required in support of this request? *(Answer 'Yes' if:*
a) any applicant named in part 3 is not an inventor, or
b) there is an inventor who is not named as an applicant, or
c) any named applicant is a corporate body.
See note (d))

Yes

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9. Enter the number of sheets for any of the following items you are filing with this form. Do not count copies of the same document

Continuation sheets of this form	0
Description	4
Claim(s)	0
Abstract	0
Drawing(s)	1 4

10. If you are also filing any of the following, state how many against each item.

Priority documents	0
Translations of priority documents	0
Statement of inventorship and right to grant of a patent *(Patents Form 7/77)*	0
Request for preliminary examination and search *(Patents Form 9/77)*	0
Request for substantive examination *(Patents Form 10/77)*	0
Any other documents *(please specify)*	0

11. I/We request the grant of a patent on the basis of this application.

Signature Date 26 March 2002

12. Name and daytime telephone number of person to contact in the United Kingdom

Roger Bousfield
(01276) 807612

Warning

After an application for a patent has been filed, the Comptroller of the Patent Office will consider whether publication or communication of the invention should be prohibited or restricted under Section 22 of the Patents Act 1977. You will be informed if it is necessary to prohibit or restrict your invention in this way. Furthermore, if you live in the United Kingdom, Section 23 of the Patents Act 1977 stops you from applying for a patent abroad without first getting written permission from the Patent Office unless an application has been filed at least 6 weeks beforehand in the United Kingdom for a patent for the same invention and either no direction prohibiting publication or communication has been given, or any such direction has been revoked.

Notes

a) *If you need help to fill in this form or you have any questions, please contact the Patent Office on 08459 500505.*

b) *Write your answers in capital letters using black ink or you may type them.*

c) *If there is not enough space for all the relevant details on any part of this form, please continue on a separate sheet of paper and write "see continuation sheet" in the relevant part(s). Any continuation sheet should be attached to this form.*

d) *If you have answered 'Yes' Patents Form 7/77 will need to be filed.*

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SEMICONDUCTOR EXHAUST GAS TREATMENT

This invention relates to the treatment (scrubbing) of semiconductor exhaust gases and, more particularly, to the treatment of fluorine or fluorine containing exhaust gases.

The utilisation of, or generation of, fluorine in certain semiconductor processes has become increasingly common in recent years. However, fluorine is a very toxic substance, being an aggressive oxidising agent and having a threshold limiting value (TLV) of 1ppm.

Attempts to scrub fluorine with ambient temperature water - primarily to form hydrogen fluoride (HF) - have generally not been successful in that fluorine reaction rates with water are relatively slow and usually result in a high emission rate from the wet scrubber.

Attempts have been made to improve the efficiency of the wet scrubbing process, for example the dosing of the scrubber with sodium hydroxide (NaOH) or potassium hydroxide (KOH) but, although this produced a greater fluorine abatement, resulted in a very high conversion of the fluorine to oxygen difluoride (OF_2) which is a very toxic by-product.

As a further example, ammonia - both in gaseous form and as ammonium hydroxide - has been used as additions to the water scrubber. However, whilst a reduction in the fluorine content was found, the formation of ammonium fluoride occurs which is emitted in the form of a fine fume from the scrubber.

There is therefore a need for an improved method/apparatus in which fluorine can be treated more efficiently and effectively so as to meet the increasingly stringent regulations regarding its disposal.

In accordance with the invention, there is provided a method of scrubbing fluorine which comprises contacting the fluorine with water at a temperature of at least 30°C. Preferably, the temperature of the water is from 40°C to 80°C. Heating of the water can be effected by traditional methods including immersion heaters within a hot sump in the scrubbing apparatus or on-line heaters in to the pumped flows.

The water may be in the form of water vapour (or steam) with the fluorine and steam being admixed in the process.

In a preferred embodiment, the process of the invention can include a hot stage and a cold stage. In the hot stage, the fluorine gas will preferentially react with the hot water but will tend to saturate the gas flow. In the subsequent second stage, there can be an effective removal of gases such as ammonia and, in reducing the gas temperature, will cause a reduction in the entrained water vapour.

It is generally known that, where silane is present in the exhaust gas, the provision of an air dilution stage is useful to prevent fire/explosion which is normally added to the inlet of a wet scrubber. However, this practice can be shown to reduce the capacity of the wet scrubber because it increases the volumetric flow rate and reduces the contact time in the scrubber of the gas(es) to be treated.

It has been found with the process of the invention in particular, that treating the silane by addition of air after the wet scrubbing stage allows for a lower mass flow and higher contact time for the fluorine. A much higher mass of added air can therefore be included in the silane flow to ensure the safe oxidation of the silane and minimisation of the temperature rise resulting from the oxidation.

For a better understanding of the invention, reference will now be made, by way of exemplification only, to the accompanying drawing which shows in schematic form apparatus for carrying out the process of the invention.

With reference to the drawing, apparatus of the invention comprises a body 1 having in the base thereof a water tank 2 divided in to two parts 3, 4 by means of a separator 5.

The part 3 acts as a water sump and is adapted to hold cold water, for example at 15°C, and the part 4 also acts as a water sump and is adapted to hold hot water, for example at 50°C to 70°C. The tank 2 possesses electrical heater and control means (not shown) to maintain the water at these temperatures.

Situated above the tank 2 within the body 1 is a two part packed tower, the lower part 6 and an upper part 7, the proprietary packings of which provide distribution channels in each part for the flow of water therethrough (and in good contact therewith) independent of the other part including channels to allow the water to be returned to the tank 2.

Two pumps 8 and 9 are provided to pump water from the cold water tank part 3 and from the hot water tank part 4 respectively in to the distribution channels of the upper packed tower part 7 and distribution channels of the packed tower part 6 respectively.

An inlet 10 is provided in the body 1 for the entry of an exhaust gas stream in to the body 1. The inlet 10 is adapted by means not shown to provide a combined aqueous liquor and nitrogen gas "curtain" in water to prevent any particulate blockage and/or liquor back-streaming towards the chamber in which the semiconductor processing is occurring.

An outlet 11 is also provided in the body 1 for the exiting of gas stream from the body 1.

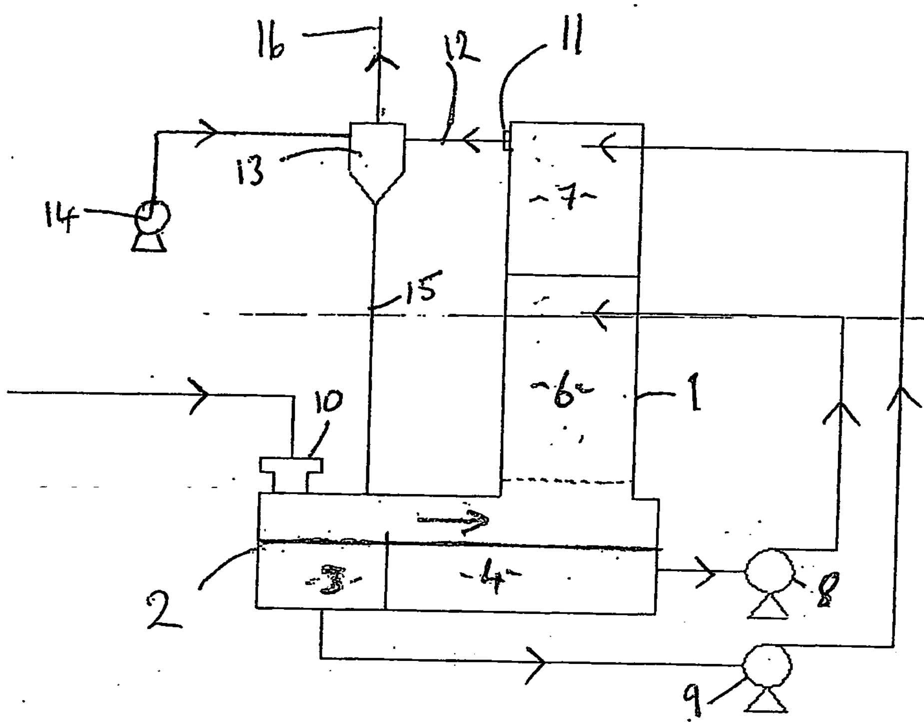
A pipe 12 links the outlet 11 with a cyclone 13 in to which the gas stream flows. Any pyrophoric gas in the stream, for example silane, will be oxidised or heavily diluted with air provided by an air blower 14 depending on the silane concentration in the gas stream. Any particulates formed during oxidation (silicon in the case of silane) can be collected at the base of the cyclone 13 (and if appropriate drained in to the tank 2 via the tube 15) with the treated exhaust gases exiting from the cyclone 13 via the tube 16.

In use of the apparatus shown in the drawing, an exhaust gas stream is pumped from the semiconductor processing chamber (not shown) by means of one or more vacuum pumps (not shown) in to the inlet 10 and thence in to the lower part 6 of the packed tower where it contacts the hot water pumped through the distribution channels formed in the packings thereof by means of the pump 8.

The distribution channels in the tower are such that the exhaust gas steam can then enter the distribution channel in the upper part 7 of the tower when it contacts the cold water pumped therethrough by means of the pump 9.

The main purpose of the lower part 6 of the packed tower is for the removal of fluorine by contact with the hot water and of any particulates entrained in the stream. ~~The remaining gases in the stream then pass in to the upper part 7 of the packed~~ tower where residual gases including ammonia are scrubbed by contact with the cold water.

The resulting gases then pass to the cyclone 13 for treatment as described above.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